

REMARKS

Reconsideration and allowance of the present patent application based on the foregoing amendments and following remarks are respectfully requested.

By this Amendment, claims 40-42, 48-49, 77, 84, 88 and 91 are amended, claims 37-39, 43, 45, 85, 87 and 89-90 are cancelled without prejudice or disclaimer to the subject matter therein, and claims 92-126 are newly added. Support for the amendments to the claims may be found throughout the original detailed description of the present patent application. No new matter has been added. Accordingly, after entry of this Amendment, claims 1-36, 40-42, 48-84, 86, 88 and 91-126 will be pending in the patent application.

Claims 37-39 were rejected under 35 U.S.C. §102(b) based on Smither (U.S. Pat. No. 5,004,319). Claims 37-39 are cancelled without prejudice or disclaimer, thus rendering moot the rejection of these claims.

Claim 40 was rejected under 35 U.S.C. §102(e) based on Gelbart (U.S. Pat. No. 6,147,789). The rejection is respectfully traversed.

Claim 40 is patentable over Gelbart at least because this claim recites an optical apparatus comprising, *inter alia*, an optical system that forms a two-dimensional image. Gelbart does not disclose, teach or suggest these features.

Gelbart discloses a deformable mirror that includes an array of silicon nitride ribbons that are metalized to reflect light. (*See* col. 2, lines 43-61). Gelbart discloses that an image is formed for each individual ribbon. (*See* FIGS. 1a-b).

However, unlike claim 40, Gelbart is silent as to an optical system that forms a two-dimensional image. Gelbart merely teaches that the ribbons are adapted to form a linear image. As such, in Gelbart, a two dimensional image can only be formed by scanning. (*See* col. 4, lines 3-11 of Gelbart). Specifically, in Gelbart, rotation of the drum 16 is needed to obtain a two-dimensional image. In contrast, according to claim 40, since the optical system itself forms a two-dimensional image, scanning is not needed. Accordingly, since none of the elements of Gelbart is capable by itself of forming a two-dimensional image, Gelbart cannot anticipate claim 40.

Accordingly, reconsideration and withdrawal of the rejection of claim 40 under 35 U.S.C. §102(e) based on Gelbart are respectfully requested.

Claims 41, 49, 87 and 89-90 were rejected under 35 U.S.C. §102(b) based on Koyama *et al.* (U.S. Pat. No. 5,793,473) (hereinafter “Koyama”). The rejection is respectfully traversed.

Claims 87 and 89-90 are cancelled without prejudice or disclaimer, thus rendering moot the rejection of these claims.

Claim 41 is patentable over Koyama at least because this claim recites an optical system wherein, *inter alia*, the variable optical-property element and the plurality of rotationally asymmetric curved surfaces are arranged along a single traveling path of rays and wherein the variable optical-property element is arranged to be decentered from an optical axis of the optical system. Koyama does not disclose, teach or suggest these features.

Koyama merely discloses a lithographic apparatus including a half-prism 4, projection lenses 5 and 17 and a reflecting mirror 6. (*See* FIG. 4). Koyama discloses that the beam is projected onto a surface of the wafer 7 coated with a photoresist material. (*See* description of the third embodiment).

However, unlike claim 41, Koyama is silent as to an optical system that includes a plurality of rotationally asymmetric curved surfaces. Contrary to what is asserted by the Office Action, element 7 does not correspond to “an optical element having a plurality of rotationally asymmetric surfaces,” but merely to a semiconductor wafer. Specifically, the substrate 7 is not a part of the optical system. Instead, substrate 7 is an object that is illuminated by the optical system. As such, substrate 7 of Koyama cannot be construed as a plurality of rotationally asymmetric curved surfaces, as recited in claim 1.

Furthermore, unlike claim 1, Koyama is silent as to a variable optical-property element and a plurality of rotationally asymmetric curved surfaces that are arranged along a single traveling path of rays. Thus, even assuming substrate 7 would correspond to the plurality of rotationally asymmetric curved surfaces, which Applicant does not concede for at least the reasons set forth above, none of the embodiments of Koyama discloses an apparatus in which the substrate 7 and the base 8 are arranged along a single traveling path of rays.

It is noted that even if the front and back surfaces of the substrate 7 in FIG. 4 of Koyama were interpreted as “a plurality of rotationally asymmetric curved surfaces,” light is reflected from the front surface of the substrate 7 without reaching the back surface of the substrate 7. That is, the back surface of the substrate 7 in Koyama is not arranged along a traveling path of rays. Similar comments can be made with respect to the embodiment shown in FIG. 6 of Koyama. As shown in FIG. 6, Koyama discloses an optical system having two

variable optical property mirrors 6, 20 and a substrate 7. Even if one of the mirrors 6, 20 were interpreted as the claimed variable optical-property element and the substrate 7 and the other one of the mirrors 6, 20 as the claimed plurality of rotationally asymmetric curved surfaces, Koyama fails to disclose that “the variable optical-property element and a plurality of rotationally asymmetric curved surfaces are arranged along a single traveling path of rays,” because the reflecting mirror 6 and the reflecting mirror 20 are not arranged along the same traveling path of rays. Rather, mirrors 6 and 20 are separately arranged along different paths of rays. Specifically, there are two traveling paths of rays in the optical system shown in FIG. 6 of Koyama: a) a first path that extends along the light source 1 - the beam splitter 4 - the reflecting mirror 6 - the beam splitter 4 - and the substrate 7; and b) a path that extends along the light source 1 - the beam splitter 4 - the reflecting mirror 20 - the beam splitter 4 - and the substrate 7. Therefore, the embodiment shown in FIG. 6 of Koyama also fails to disclose the features of claim 41.

Moreover, unlike claim 1, Koyama is silent as to a variable optical-property element that is arranged to be decentered from an optical axis of the optical system. Koyama merely discloses that the reflecting mirrors (6 or 20) are aligned along the optical axis. As such, mirrors 6 and 20 are not decentered.

Accordingly, for at least these reasons, claim 41 cannot be anticipated by Koyama.

Claim 49 is patentable over Koyama for at least similar reasons as provided in claim 41. Namely, claim 49 is patentable over Koyama at least because this claim recites an optical system comprising, *inter alia*, an optical element having a light-deflecting function and disposed before or after the variable optical-property mirror in a single traveling path of rays, wherein a shape of a reflecting surface of the variable optical-property mirror is changeable, wherein the variable optical-property mirror is arranged to be decentered from a light-incident-side optical axis, and wherein the optical element has a rotationally asymmetric surface having a shape that defines only one plane of symmetry or no plane of symmetry. Koyama does not disclose, teach or suggest these features.

As mentioned previously, the substrate 7 of Koyama is not part of the optical system. Instead, the substrate 7 is an object that is illuminated by the optical system. As such, the substrate 7 cannot be construed as an optical element having a rotationally asymmetric surface having a shape that defines only one plane of symmetry or no plane of symmetry.

Furthermore, for at least similar reasons as provided above for claim 41, Koyama is silent as to an optical element having a light-deflecting function and disposed before or after

the variable optical mirror in a single traveling path of rays. None of the embodiments of Koyama discloses, teaches or suggests these features.

Likewise, Koyama is silent as to a variable optical-property element that is arranged to be decentered from a light-incident-side optical axis. For at least these reasons, Koyama cannot anticipate claim 49.

Accordingly, reconsideration and withdrawal of the rejection of claims 41, 49, 87 and 89-90 under 35 U.S.C. §102(b) based on Koyama are respectfully requested.

Claims 77-78 and 91 were rejected under 35 U.S.C. §102(b) based on Pepper (U.S. Pat. No. 5,046,821). The rejection is respectfully traversed.

Claim 77 is patentable over Pepper at least because this claim recites an optical apparatus comprising an optical system that forms a two-dimensional image, the optical system comprising, *inter alia*, a plurality of variable optical-property elements each having a reflecting surface that is deformable. Pepper does not disclose, teach or suggest these features.

Pepper discloses an apparatus including liquid crystal light valves 2, 8 and 14 that comprise a liquid crystal layer and a photoconductive substrate layer. (*See* FIG. 1 and col. 3, lines 54-56). Pepper discloses that the beam 20 passes through the liquid crystal layer 4 and is reflected at the mirror interface between the photoconductive substrate (PC) 6 and LC 4 as a first reflected beam. (*See* col. 3, lines 63-68).

However, unlike claim 77, Pepper is silent as to a plurality of variable optical-property elements each having a reflecting surface that is deformable. Specifically, the optical surface of each of the liquid crystal light valves (2, 8, 10) of Pepper does not have a reflecting surface that is deformable. The variable optical-property element of Pepper is merely a light valve having a liquid crystal layer that is formed on a non-deformable plane reflecting surface 6, 12 and 18. Therefore, according to Pepper, although the state of the liquid crystal is changeable, to have a variable refractive index, the optical power of the variable optical-property element is not changeable. As such, the device shown in Pepper is limited to a particular use, such as the compensation of wavefront aberration. In contrast, according to claim 77 of the present invention, each of the variable optical-property elements has a reflecting surface that is deformable in order to have a variable optical power. For at least these reasons, claim 77 cannot be anticipated by Pepper.

Claim 78 is patentable over Pepper at least by virtue of its dependency from claim 77 and for the additional features recited therein.

Claim 91 is patentable over Pepper for at least similar reasons as provided above for claim 77. Namely, claim 91 is patentable over Pepper at least because this claim recites an optical apparatus comprising, *inter alia*, a plurality of variable optical-property elements, wherein each of the variable optical-property elements is arranged to be decentered from a light-incident-side optical axis. As mentioned previously, these features are not disclosed by Pepper.

Accordingly, reconsideration and withdrawal of the rejection of claims 77-78 and 91 under 35 U.S.C. §102(b) based on Pepper are respectfully requested.

Claims 84-86 and 88 were rejected under 35 U.S.C. §102(b) based on Molstrom (U.S. Pat. No. 3,923,370). The rejection is respectfully traversed.

Claim 85 is cancelled without prejudice or disclaimer, thus rendering moot the rejection of this claim.

Claim 84 is patentable over Molstrom at least because this claim recites an optical device comprising, *inter alia*, a variable optical-property element and a rotationally asymmetric reflecting surface, wherein the rotationally asymmetric reflecting surface defines only one plane of symmetry or no plane of symmetry. Molstrom does not disclose, teach or suggest these features.

Molstrom discloses an optical system for a head mounted display. (*See* FIG. 2). Molstrom discloses that this optical system has a plurality of reflecting surfaces (areas 20, 30, mirror 24). In Molstrom, light reflected by the plurality of reflecting surfaces is incident on the eye of the pilot. (*See* FIGS. 1-3 of Molstrom).

However, contrary to what is asserted by the Office Action, the eye of the pilot in Molstrom cannot be construed as a variable optical-property element as recited in claim 84 because the eye of the pilot is not part of the optical device that forms the head mounted display. In particular, when the display of Molstrom is not mounted to the head of the pilot, the head mounted display would not comprise a variable optical-property element and, therefore, would not meet the limitations of claim 84. Accordingly, one of ordinary skill in the art would clearly not construe the eye of the pilot as being comprised within the optical assembly.

The examiner alleged that the mirrors 20, 30 of Molstrom are paraboloid. However, the term “paraboloid” merely refers to the sectional shape of a surface. It is not known from the disclosure of Molstrom whether the surfaces of mirrors 20, 30 are rotationally symmetric or asymmetric.

Claim 86 is patentable over Molstrom at least by virtue of its dependency from claim 84 and for the additional features recited therein.

Claims 88 depends from claim 41 and is patentable over Molstrom for at least similar reasons as provided above and for the additional features recited therein. Namely, claim 88 is patentable over Molstrom at least because this claim recites an optical system comprising, *inter alia*, a variable optical-property element. As mentioned previously, Molstrom is silent as to such an element. Accordingly, Molstrom cannot anticipate claim 88.

Accordingly, reconsideration and withdrawal of the rejection of claims 84-86 and 88 under 35 U.S.C. §102(b) based on Molstrom are respectfully requested.

Claims 41, 43, 84, 86 and 88 were rejected under 35 U.S.C. §102(b) based on Rambauske (U.S. Pat. No. 3,950,079). The rejection is respectfully traversed.

Claim 43 is cancelled without prejudice or disclaimer, thus rendering moot the rejection of this claim.

Claim 41 is patentable over Rambauske at least because this claim recites an optical system comprising, *inter alia*, a variable optical-property element and a plurality of rotationally asymmetric curved surfaces, the variable optical-property element, and the plurality of rotationally asymmetric curved surfaces are arranged along a single traveling path of rays and wherein the variable optical-property element is arranged to be decentered from an optical axis of the optical system. Rambauske does not disclose, teach or suggest these features.

Rambauske is merely directed to a catoptric arrangement including a plurality of mirrors 12, 14, 16 and 18. (See FIG. 1 of Rambauske).

However, contrary to what is asserted by the Office Action, the aspherical surfaces of Rambauske are rotationally symmetric. These surfaces are created by rotating the generatrix drawn with the heavy curves about the principal axis of the parabola 12a. (See col. 3, lines 39-54 regarding the reflecting surfaces 12, 14, and col. 4, lines 8-18 regarding the reflecting surfaces 16, 18, and Fig. 1 of Rambauske). Rambauske fails to disclose a plurality of rotationally asymmetric surfaces.

Furthermore, although the rotationally symmetric mirrors of Rambauske rotate, their characteristic as a mirror is invariable. By contrast, the present invention discloses, as examples of the variable optical-property element, various types of deformable mirrors and liquid crystal elements. The former changes the optical power of the reflecting surface thereof by deformation of the surface shape, and the latter changes the optical power by

changing the refractive index or changes the wavefront status of light transmitted through the liquid crystal element (in the case of the reflecting-type liquid crystal element shown in Fig. 58, also, light is transmitted through the liquid crystal portion). Applicant respectfully submits that when the characteristics of an optical element are changeable, the optical element is referred to as a variable optical-property element regardless of whether the optical element moves in its entirety or not. In Rambauske, the optical characteristics of the reflecting surfaces do not change. Rambauske merely discloses changing the geometrical position of the reflecting surface. Accordingly, such an optical element is not a variable optical-property element. Accordingly, Rambauske cannot anticipate claim 41.

Claim 84 is patentable over Rambauske at least because this claim recites an optical device comprising, *inter alia*, a variable optical-property element and a rotationally asymmetric reflecting surface, wherein the rotationally asymmetric reflecting surface defines only one plane of symmetry or no plane of symmetry. Rambauske does not disclose, teach or suggest these features for at least similar reasons as provided above.

Claim 86 is patentable over Rambauske at least by virtue of its dependency from claim 84 and for the additional features recited therein. Similarly, claim 88 is patentable over Rambauske at least by virtue of its dependency from claim 41 and for the additional features recited therein.

Accordingly, reconsideration and withdrawal of the rejection of claims 41, 43, 84, 86 and 88 under 35 U.S.C. §102(b) based on Rambauske are respectfully requested.

Claims 42, 43 and 48 were rejected under 35 U.S.C. §103(a) based on Koyama in view of Pepper. This rejection is respectfully traversed.

Claim 43 is cancelled without prejudice or disclaimer, thus rendering moot the rejection of this claim.

Claim 42 is patentable over Koyama at least by virtue of its dependency from claim 41 and for the additional features recited therein. Namely, claim 42 is patentable over Koyama at least because this claim recites an optical system wherein, *inter alia*, the variable optical-property element and the plurality of rotationally asymmetric curved surfaces are arranged along a single traveling path of rays, wherein the variable optical-property element is arranged to be decentered from an optical axis of the optical system and wherein the plurality of rotationally asymmetric curved surfaces are provided on a single optical element.

Pepper fails to remedy the deficiencies of Koyama. In particular, Pepper fails to disclose, teach or suggest a plurality of rotationally asymmetric curved surfaces provided on a

single optical element. As such, any reasonable combination of Koyama and Pepper cannot result, in any way, in the invention of claim 42.

Furthermore, Applicant respectfully submits that there is no motivation or suggestion to combine the teachings of Koyama and Pepper. These references have nothing in common as evidenced at least by their separate classifications. As such, in the absence of impermissible hindsight based on Applicant's own specification, there is no reason as to why one of ordinary skill in the art would be motivated to combine Koyama and Pepper.

Claim 48 is patentable over Koyama, Pepper and a combination thereof at least by virtue of its dependency from claim 42 and for the additional features recited therein.

Accordingly, reconsideration and withdrawal of the rejection of claims 42, 43 and 48 under 35 U.S.C. §103(a) based on Koyama in view of Pepper are respectfully requested.

Claims 92-126 are newly added to define additional subject matter that is novel and non-obvious. Claims 92-126 are fully supported by the original disclosure. Applicant respectfully submits that claims 92-126 are in condition for allowance.

Applicant has addressed the Examiner's rejections and respectfully submits that the application is in condition for allowance. A notice to that effect is earnestly solicited.

If any point remains in issue which the Examiner feels may be best resolved through a personal or telephone interview, please contact the undersigned at the telephone number listed below.

Please charge any fees associated with the submission of this paper to Deposit Account Number 033975. The Commissioner for Patents is also authorized to credit any over payments to the above-referenced Deposit Account.

Respectfully submitted,

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